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Title of the Invention: COATING COMPOSITION

Application Number: 51-22676

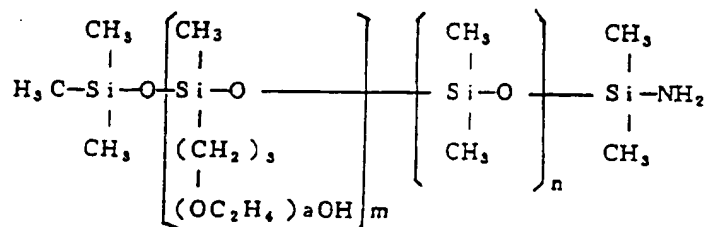
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## Claims

1. A coating composition comprising a water-soluble silicone represented by the general formula:



(wherein "a", "m" and "n" are integral numbers), a carboxyl-group-containing water-soluble synthetic resin, and a crosslinking agent.

2. A coating composition according to claim 1, wherein "m" is 2 to 6, "m"+"n" is 4 to 10, and "a" is a number which allows the total molecular weight of the  $(\text{OC}_2\text{H}_4)_a\text{OH}$  portion and the molecular weight of the remaining portion to be substantially equal to each other in the water-soluble silicone.

## SHUSAKU YAMAMOTO

3. A coating composition according to claim 1, wherein "m" is 4, "n" is 4, and "a" is 4.5 on average in the water-soluble silicone.

### Detailed Description of the Invention

The present invention relates to a coating composition having an outstanding heat resistance and water-solubility preferable to form a protective coating film which has an outstanding repellency on an aluminum material (including aluminum and aluminum alloy), or the like.

Conventionally, the aluminum material is used for various building materials such as window frames, etc. However, the surface of the aluminum material is very easily oxidized. Therefore, an aluminum oxide film is normally formed by an anode oxidation treatment. On this oxide film, a thermosetting water-soluble coating (including a crosslinking agent) is painted by immersion, and then cured by baking so as to form a protective coating film.

However, the protective coating film which is formed as described above is weak in repellency, and has caused extremely serious problems as a building material. For example, in the case of a concrete building, the inside of the house is almost completely sealed from the outside, especially during the winter period when the temperature of the inside and that of the outside of the building are substantially different, droplets are attached to the surface of the window frame, etc., and the so-called dew condensation phenomenon occurs. In a very cold region such as Hokkaido, the droplets which are caused by dew condensation freeze and removing the frozen droplets has been a big problem.

Moreover, even in the region where it is not so cold, a part of the droplets, which are attached on the window frame, etc., permeate through the coating film. Therefore, even if

## SHUSAKU YAMAMOTO

the oxide film is formed as the protective film on the surface of the aluminum material, this oxide film will be eroded by the permeating water. Furthermore, the aluminum material itself, which is the base material, could also be eroded.

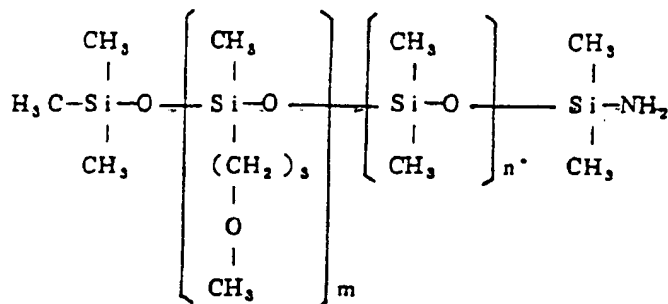
In addition, although the above-described bake-curing temperature varies according to the nature of the water-soluble coating in use, normally the temperature is around 180°C. When the bake-curing is done at a temperature higher than this, the coating film changes to the color yellow, and the efficiency of the coating film rather deteriorates, which is not preferable.

Moreover, in the total process of the aluminum material from the extrusion to the bake-curing of the coating film, there are processes such as extrusion→aging treatment→conversion treatment→painting→bake-curing of coating film. In particular, the two processes of the aging treatment and the bake-curing of the coating film need substantial consumption of electricity or heat energy, therefore, the omission or the saving of those processes has been desired.

Thus, the present inventors have repeatedly studied this process, and proposed and carried out a method in which the aging treatment and the bake-curing of the coating film are not individually performed, but in which the extrusion is followed by the conversion treatment and then by the painting process, after which the aging treatment and the bake-curing of the coating film are performed at once.

However, in carrying out this method, when using a so-called "A · A6063" alloy as the aluminum material, the aging temperature was required to be at least  $205 \pm 5^\circ\text{C}$ . It was not preferable to cure by baking the coating film at this aging

# SHUSAKU YAMAMOTO



and ethylene glycol.

A carboxyl-group-containing water-soluble synthetic resin used in the coating composition according to the present invention includes a carboxyl group, and preferably also includes the hydroxyl group for reactivity with the above-described water-soluble silicone, for water-solubility of the coating composition and for reactivity with the crosslinking agent. In the present invention, as long as the water-soluble synthetic resin contains a carboxyl group, it may be either polymer or copolymer of any monomer. The monomers that may be used include acrylic acid or methacrylic acid, or a mixture of such acids with an ester thereof, acrylamide, and acrylonitrile, or the like.

Water-soluble synthetic resins preferable for use in the present invention include a copolymer of a monomer mixture having the composition as described below.

butyl acrylate	50-80	wt%
methyl methacrylate	5-30	wt%
acrylic acid	5-15	wt%
hydroxyethyl	5-30	wt%
methacrylate		

In the coating composition according to the present invention, the water-soluble silicone and the carboxyl-group-containing water-soluble synthetic resin are both water-

## SHUSAKU YAMAMOTO

soluble, therefore, the coating composition is water-soluble as well.

Moreover, when subjected to a high temperature after painting, both resins are prone to form a tough coating film after the progress of the polymerization. If a proper crosslinking agent is premixed in the coating composition having the resins, a crosslinking reaction progresses between the resins even at a relatively low temperature so as to form the coating film outstanding in heat resistance. For the type of the crosslinking agent, it could be any type as long as it crosslinks with the carboxyl-group-containing water-soluble synthetic resin. For example, hexamethylol-melamine is preferable.

Additionally, it is preferable to add a stabilizer so that each component of the water-soluble coating will stabilize and that no reaction will occur at a room temperature. As a stabilizer in this sense, amines are preferable, and 2-dimethylaminoethanol is particularly preferable among other amines.

The coating composition according to the present invention includes an organic solvent, water, etc., such as for common water-soluble coatings. By this organic solvent, each of the above-described components can be sufficiently dissolved and mixed with water.

Normally in this case, it is preferable to use ethylene glycol monobutyl ether, ethylene glycol monoethyl ether, etc., as the organic solvent.

The coating composition according to the present invention is crosslinked by the bake-curing, and the coating film

## SHUSAKU YAMAMOTO

formed by the bake-curing has the outstanding repellency because of the existence of the silicone component.

### Example

Firstly, each monomer whose composition is shown in Table 1, a solvent and a catalyst were put into a pressure resisting reaction apparatus (gage pressure 0-0.5kg/cm<sup>2</sup>). N<sub>2</sub> gas was charged into the apparatus, and the apparatus was heated gradually so as to synthesize an acrylic resin.

Table 1

Monomer	Composition (parts by weight)
butyl acrylate	66.20
acrylic acid	8.00
methyl methacrylate	7.30
hydroxylethyl methacrylate	18.50
azoisobutylnitrile	0.05
ethylene glycol monobutyl ether	66.70
Total	166.75 (parts)

When synthesizing this acrylic resin, in order to avoid an abnormal reaction due to the reaction heat, water was passed through the apparatus so that the temperature rises gradually. After about 90 minutes, the temperature was kept at 80°C for 6 hours, then the temperature was lowered and kept at 50°C for 2 hours, thereby synthesizing the acrylic resin.

Then, the coating composition according to the present invention was made by mixing the synthesized acrylic resin with a water-soluble silicone, a crosslinking agent, a stabilizer, an organic solvent and water according to the composition shown in Table 2.

# SHUSAKU YAMAMOTO

Table 2

	Composition (parts by weight)
acrylic resin	27.4
water-soluble silicone	4.8
hexamethylolmelamine	14.4
amine	3.5
ethylene glycol monobutyl ether	15.9
ethylene glycol monoethyl ether	23.0
water	91.0

After producing the water-soluble coating as described above, the coating was used for painting on aluminum material 6063 as follows, and the properties of the coating film were examined.

Specifically, after the aluminum material 6063 was extruded into a predetermined shape, pre-treatment and a base film raw treatment were done in an ordinary method without any aging treatment. Next, a coating film having a thickness on the order of a  $\mu$  was formed on the aluminum material by immersing the aluminum material in the coating composition (temperature at 40°C) shown in Table 2 for 30 seconds under conditions including a setting temperature of 40°C, a setting time of 10 minutes, and a finishing speed of 0.7 m/minute.

Thereafter, the aluminum material was heated under the condition of 210°C x 60 minutes, and the coating film was cured by baking while the aging of the aluminum material was in progress.

The results of a performance test of the coating film obtained by the above-described method are shown in Table 3. Additionally, for the purpose of comparison, electro-

# SHUSAKU YAMAMOTO

deposition coating, solvent acrylic coating and acrylic urethane coating were respectively painted on an aluminum alloy material, and the properties of the coating films were tested as well. The results are also shown in Table 3.

Table 3

Coating	Performance	Surface wetting test
coating composition of the present invention (example)		5
electro-deposition coating		3
acrylic coating		3
acrylic urethane coating		-

Herein, each value shown in Table 3 is an evaluation value. The test and the evaluation were done as follows.

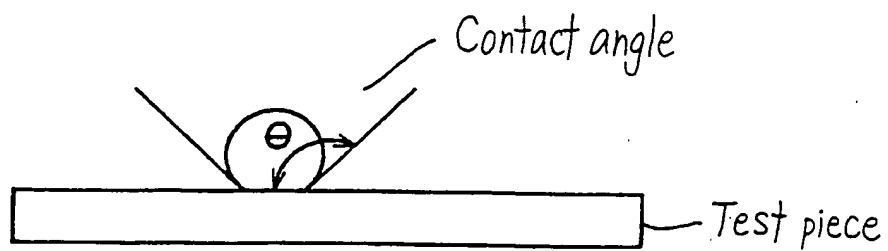
A droplet of about  $1.5\mu$  in diameter was dropped on each of the test pieces, a, and a contact angle  $\theta$  was determined after 3 minutes. The evaluation value was determined as follows based on the value of  $\theta$ :

- 5...180-160°
- 4...159-140°
- 3...139-120°
- 2...119-100°
- 1...99-80°

## Brief Description of the Drawings

The drawing illustrates the contact angle  $\theta$ .





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